

# Biological Information Technology & Systems (BITS)

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## *Program Announcement*

*NSF 01-102*

DIVISION OF EXPERIMENTAL AND INTEGRATIVE ACTIVITIES  
DIRECTORATE FOR COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

**LETTER OF INTENT DUE DATE(S) (*optional*): June 8, 2001**

**FULL PROPOSAL DEADLINE(S):**

**July 6, 2001; Second Friday in February 2002 and thereafter**  
*optional letter of intent is requested 4 weeks in advance of the due date*



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## SUMMARY OF PROGRAM REQUIREMENTS

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### GENERAL INFORMATION

**Program Title:** Biological Information Technology & Systems (BITS)

**Synopsis of Program:** The Biological Information Technology and Systems (BITS) Program will support high risk/high return research at the interface of biology and information technology. Biological systems have enormous capabilities as powerful and agile control systems for robotic and regulatory systems, and for pattern recognition, adaptability, information storage, retrieval and processing, sensor fusion and other information-handling tasks. Biology often performs orders of magnitude better than systems based on today's silicon device technologies. Determining what needs to and what can be learned about information processing in biological systems should lead to important new information systems (algorithms, software and systems) and technologies (computer platforms, sensors, robotic devices, etc.). The initial phase of this program will focus on developing computational models and theories for the information processing mechanisms encountered in biological systems that will lead to new information technology systems and hardware platforms. While these new information technology systems will not necessarily or exclusively be implemented in biological matter, the Program will emphasize hybrid (bio-silical) systems, particularly as a means for experimenting with and validating new theories of biological information technologies and systems.

**Cognizant Program Officer(s):**

- Frederica Darema, Senior Science and Technology Advisor, Computer and Information Science and Engineering, Experimental and Integrative Activities, 1060N, telephone: 703-292-8980, e-mail: [fdarema@nsf.gov](mailto:fdarema@nsf.gov).
- James Hickman, Special Advisor to the Division Director, Computer and Information Science and Engineering, Experimental and Integrative Activities, 1060N, telephone: 703-292-8980, e-mail: [jhickman@nsf.gov](mailto:jhickman@nsf.gov).

**Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):**

- 47.070 --- Computer and Information Science and Engineering

### ELIGIBILITY INFORMATION

- **Organization Limit:** None

- **PI Eligibility Limit:** None
- **Limit on Number of Proposals:** None

## **AWARD INFORMATION**

- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 20-30
- **Anticipated Funding Amount:** \$5 million for FY 2001; \$8 million for FY 2002; approximately 15-20 awards of 3-5 years in duration; amounts ranging between \$100,000 to 200,000/year for theoretical proposals and \$100,000 to 500,000/year for hybrid systems and other experimental projects

## **PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS**

### ***A. Proposal Preparation Instructions***

- **Letters of Intent:** Submission of Letters of Intent is optional. Please see the full program announcement/solicitation for further information.
- **Full Proposals:** Standard Preparation Guidelines
  - Standard GPG Guidelines apply.

### ***B. Budgetary Information***

- **Cost Sharing Requirements:** Cost Sharing is not required.
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Limitations:** Not Applicable.

### ***C. Deadline/Target Dates***

- **Letters of Intent (*optional*):** June 8, 2001
- **Preliminary Proposals (*optional*):** None
- **Full Proposal Deadline Date(s):**

July 6, 2001;    Second Friday in February 2002 and thereafter  
*optional letter of intent is requested 4 weeks in advance of the due date*

### ***D. FastLane Requirements***

- **FastLane Submission:** Required

- **FastLane Contact(s):**

- Helen Walston, Senior Program Assistant, CISE, EIA, 1060N, telephone: (703) 292-8980, e-mail: [hwalston@nsf.gov](mailto:hwalston@nsf.gov).

## **PROPOSAL REVIEW INFORMATION**

- **Merit Review Criteria:** National Science Board approved criteria. Additional merit review considerations apply. Please see the full program announcement/solicitation for further information.

## **AWARD ADMINISTRATION INFORMATION**

- **Award Conditions:** Standard NSF award conditions apply.
- **Reporting Requirements:** Standard NSF reporting requirements apply.

## I. INTRODUCTION

Research at the interface of biology and information technology has the potential to lead to important new information systems (algorithms, software and systems) and technologies (computer platforms, sensors, robotic devices, etc.). Biological systems have enormous capabilities as powerful and agile control systems for robotic and regulatory systems, and for pattern recognition, adaptability, information storage, retrieval and processing, sensor fusion and other information-handling tasks. In these and other domains, biology can perform orders of magnitude better than systems based on today's digital computer architectures and software designs, even though the latter are implemented on silicon device technologies that achieve ultra high speeds.

The Biological Information Technology and Systems Program (BITS) hopes to exploit the enormous potential of biological information technology and systems by developing new computational models and theories that then will lead to new information technology systems and hardware platforms inspired by the information processing mechanisms encountered in biological systems. The initial phase of this program will focus on what needs to and what can be learned about information processing in biological systems, and how this new understanding can be applied towards developing new information and computer technologies. In particular, the BITS Program will support research on computational models and theories for the information processing mechanisms encountered in biological systems that will lead to new information technology systems and hardware platforms. While these new information technology systems will not necessarily or exclusively be implemented in biological matter, the Program will emphasize hybrid (bio-silical) systems, particularly as a means for experimenting with and validating new theories of biological information technologies and systems.

Bio-computation and bio-computing are used as catch-all terms for research at the interface of biology and computation, but these terms are used in so many ways and for such different subsets of this intersection as to cause confusion. NSF conducted two workshops that brought together scientists from biology, engineering, neuroscience, chemistry, mathematics, physics and computer and computational sciences to address the challenges and to define the scope of research at the Bio-IT interface. These are:

"Synergistic Approaches for Understanding Information Processing in Biological and Artificial Intelligent Systems," held on April 8-10, 1996.

"Biological Computation: How does biology do information technology," held on September 21, 2000.

These reports may be accessed at <http://www.cise.nsf.gov/eia/index.html>

At the most recent workshop, attendees suggested that the general area of bio-computation or bio-computing could be divided into four categories: **computational biology**, **bio-informatics**,

**bio-molecular computing**, and **biological computation**. The BITS Program is intended to address the last category:

**Biological computation:** integrates research in many areas (biology, chemistry, physics, computing, mathematics, engineering) and applies the tools of computational biology and bio-informatics to *understanding* computation and information flow in biological systems from the molecular and cellular levels, to the multi-cellular levels and beyond.

Researchers with interests in bio-molecular computing, computational biology or bio-informatics should consider the programs listed in Section IX of this announcement. A companion program to BITS, the Quantum and Biologically Inspired Computing (QuBiC) Program (see Section IX) is intended to stimulate research in areas of quantum information science (QIS) and areas that unify information sciences, quantum foundations and biology at the molecular level. The BITS program deals with research on biologically-inspired systems as exhibited by cellular and multi-cellular systems and mechanisms.

While research in biological computation or biological information technology and systems is expanding, only a few programs that support research in this area exist, and often they are very application-oriented. This is due, to some extent, to a perception that biological mechanisms are too slow compared to silicon-based systems to serve as a serious model for information processing. A frequent analogy compares a transistor switching at gigahertz rates to a neuron firing at millihertz. However, this analogy fails to capture the complexity exhibited and managed by biology and nature through clearly efficient and powerful forms of information processing. A more realistic analogy may be to compare a neuron to a processor and a transistor to protein-protein interactions, that occur in the pico- or femto-second range.

Biology has the potential to serve as a powerful model for the development of revolutionary new concepts in software and hardware, and to help create the information technology systems of the future. This Program seeks to define the range, the extent and the bounds of applicability of biological mechanisms involved in information processing, and how to understand and develop the means of implementing new IT methods, tools, processes, systems and hardware based on them. A focused and significant-scale basic research program in the area of biological computation is required to address these challenges and opportunities. A directed effort over next 5 to 20 years could lead to the same kind of revolution that Very Large Scale Integrated circuit technology and the electronics industry have enabled over the last 30-40 years.

## II. PROGRAM DESCRIPTION

The BITS Program will focus on three main areas: **models and frameworks** for representing biological computation; **hybrid systems**, particularly for *in vitro* experimentation with and validation of these models; and **biologically-inspired systems**, new computing systems that draw inspiration from a systems biology perspective (i.e., multi-cell systems, organs, whole organisms, as well as populations of organisms from bacteria to human).

Research in computational biology and bioinformatics includes developing data-analytical and theoretical methods, mathematical modeling and computational simulation techniques for the study of biological, behavioral and social systems. These techniques are applied, for example, to protein-protein interactions, protein folding, drug binding site elucidation, etc.; as well as for predicting gene function, coordination, regulation, and role in phenotype determination. Also, *in silico* models and frameworks are used to model the pathways inside cells to develop *predictive methods* primarily for functional genomics and drug lead analysis. However, these **models and frameworks** can be extended to develop an *understanding* of the workings of the cell, in order to determine the "algorithms" and "computational elements" that represent the biological computation going on within the cell. The BITS Program is interested in supporting *in silico* models and frameworks, to the extent that they will lead to a better understanding and to new theories of biological computation. The goal is for these theories, based on discrete, continuous, linear, non-linear, dynamical, hybrid, or any appropriate mathematical model, to lead to new information technology and systems.

A second area of emphasis is **hybrid systems**. This area is described as an effort to establish information transfer between cells, tissue (such as slice preparations), and higher order organisms with silicon-based devices such as solid-state microelectrodes, implants, and other transduction methodologies. These hybrid systems will serve as a means for experimenting and validating *in vitro* the theories developed from *in silico* models and frameworks. Experimentation could include trying to train individual neurons or collection of neurons on or a chip to learn complex behaviors such as XOR or parity functions; or to interact directly with silicon systems as chaotic control devices. Other examples of research might include experiments: to test the possibility that biological neurons could include a molecular-based quantum associative memory capability in the cytoskeleton, that could enhance the computational capability of a single neuron; or to employ neuronal networks on implants for understanding motion theory, research that could have robotics and other applications.

Systems Biology brings to biological computation research a perspective on multi-cell systems, organs, whole organisms, as well as populations of organisms from bacteria to human that may lead to **biologically-inspired systems**. Research could also include plant ecosystems and other systems that may have or suspect have communicative abilities. This third area of emphasis seeks biological inspiration from the cellular to ecosystem level and distinguishes the BITS Program from the QuBiC Program cited above, which looks for inspiration from the atomic to the molecular level.

In FY2001, the BITS Program will focus on research at the cellular level, and, thus primarily, the first two areas of emphasis: new theories of biological computation and hybrid systems. Bio-molecular interactions at the sub-cellular level would be the purview of the QuBiC program, however, proposals that overlap the two programs may be jointly funded. In the first year, the Program also will entertain smaller (exploratory research) proposals in all three areas of emphasis at the cellular, multi-cellular level and above. In FY2002 and later years, the BITS Program plan to expand to a broad-based program of research in biological computation that draws on research in biology, engineering, neuroscience, chemistry, mathematics and computer

science. The Program will entertain interesting and revolutionary concepts in all areas of Biological Information Technology and Systems at any time. In all cases, proposals **must** contribute to advancing information technology research and applications. The potential to achieve breakthroughs that will lead to the next generation algorithms, software and hardware is a particularly important selection criterion.

Each year and well in advance of the due date, the BITS Program web page (accessible at the NSF/CISE/EIA web page <http://cise.nsf.gov/eia>) will include information on the areas of particular interest of that competition. Examples of the areas of interest for FY 2001 include, but are not limited to:

- Theories, Models and Frameworks (purely theoretical or in combination with experimental work):
  - New theories and models that extend current computing and/or information theory to incorporate and explain biological computation.
  - New theories and models of computation that go beyond computing and/or information theory, for example non-linear dynamical systems, hybrid systems, etc. that show promise for leading to new information technologies and systems.
  - Models of cells, tissue, or organisms interacting with silicon devices.
- Hybrid Systems (purely experimental or in combination with theoretical work):
  - Integration of cells or small numbers of cells with silicon chips or other devices.
  - Integration of intact tissue, such as hippocampal brain slices with silicon chips or other devices.
  - Integration of living organisms with silicon based multielectrode implants or similar devices.
  - Biosensors and other devices that incorporate cells or cellular systems.
  - Neuromorphic Systems.

### III. ELIGIBILITY INFORMATION

The categories of proposers identified in the [Grant Proposal Guide](#) are eligible to submit proposals under this program announcement/solicitation.

### IV. AWARD INFORMATION

Approximately 15-20 awards of 3-5 years in duration will be made each year. Amounts will range between \$100,000 to 200,000/year for theoretical proposals and \$100,000 to 500,000/year for hybrid systems and other experimental projects. The planned Program budget is \$5 million for FY 2001; \$8 million for FY 2002. Actual program budget, number of awards and average award size/duration are subject to the availability of funds.

### V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

#### A. Proposal Preparation Instructions

##### Letters of Intent:

##### Full Proposal:

Proposals submitted in response to this program announcement/solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF *Grant Proposal Guide* (GPG). The complete text of the GPG is available electronically on the NSF Web Site at: <http://www.nsf.gov/cgi-bin/getpub?nsf012>. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

Proposers are reminded to identify the program solicitation number (NSF 01-102) in the program announcement/solicitation block on the NSF Form 1207, *Cover Sheet For Proposal to the National Science Foundation*. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

#### B. Budgetary Information

Cost sharing is not required in proposals submitted under this Program Announcement.

#### C. Deadline/Target Dates

Proposals must be submitted by the following date(s):

**Letters of Intent (optional):** June 8, 2001

**Full Proposals by 5:00 PM local time:**

July 6, 2001; Second Friday in February 2002 and thereafter  
*optional letter of intent is requested 4 weeks in advance of the due date*

## **D. FastLane Requirements**

Proposers are required to prepare and submit all proposals for this Program Announcement through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at: <http://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call 1-800-673-6188.

*Submission of Signed Cover Sheets.* The signed copy of the proposal Cover Sheet (NSF Form 1207) must be postmarked (or contain a legible proof of mailing date assigned by the carrier) within five working days following proposal submission and be forwarded to the following address:

National Science Foundation  
DIS – FastLane Cover Sheet  
4201 Wilson Blvd.  
Arlington, VA 22230

## **VI. PROPOSAL REVIEW INFORMATION**

### **A. NSF Proposal Review Process**

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

Proposals will be reviewed against the following general review criteria established by the National Science Board. Following each criterion are potential considerations that the reviewer may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Each reviewer will be asked to address only those that are relevant to the proposal and for which he/she is qualified to make judgements.

#### **What is the intellectual merit of the proposed activity?**

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

### **What are the broader impacts of the proposed activity?**

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Principal Investigators should address the following elements in their proposal to provide reviewers with the information necessary to respond fully to both of the above-described NSF merit review criteria. NSF staff will give these elements careful consideration in making funding decisions.

#### ***Integration of Research and Education***

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

#### ***Integrating Diversity into NSF Programs, Projects, and Activities***

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

#### **Additional Review Criteria**

Proposals **must** be directly relevant to information technology research and applications.

Proposals will be reviewed on the potential to achieve breakthroughs that will lead to the next generation algorithms, software and hardware.

Submissions must demonstrate familiarity with prior work in the area proposed.

All Principal Investigators and teams must demonstrate a well integrated expertise in computer science.

A summary rating and accompanying narrative will be completed and signed by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

## **B. Review Protocol and Associated Customer Service Standard**

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Panel Review.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

NSF will be able to tell applicants whether their proposals have been declined or recommended for funding within six months for 95 percent of proposals. The time interval begins on the proposal deadline or target date or from the date of receipt, if deadlines or target dates are not used by the program. The interval ends when the Division Director accepts the Program Officer's recommendation.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at its own risk.

## **VII. AWARD ADMINISTRATION INFORMATION**

### **A. Notification of the Award**

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program Division administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See section VI.A. for additional information on the review process.)

### **B. Award Conditions**

An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (NSF-GC-1)\* or Federal Demonstration Partnership (FDP) Terms and Conditions \* and (5) any announcement or other NSF issuance that may be incorporated by reference in the

award letter. Cooperative agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

\*These documents may be accessed electronically on NSF's Web site at [http://www.nsf.gov/home/grants/grants\\_gac.htm](http://www.nsf.gov/home/grants/grants_gac.htm). Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Web site at <http://www.nsf.gov/cgi-bin/getpub?gpm>. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Web site at <http://www.gpo.gov>.

### **C. Reporting Requirements**

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Approximately 30 days before expiration, NSF will send a notice to remind the PI of the requirement to file the final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

NSF has implemented an electronic project reporting system, available through FastLane. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system.

## **VIII. CONTACTS FOR ADDITIONAL INFORMATION**

General inquiries regarding Biological Information Technology & Systems should be made to:

- Frederica Darema, Senior Science and Technology Advisor, Computer and Information Science and Engineering, Experimental and Integrative Activities, 1060N, telephone: 703-292-8980, e-mail: [fdarema@nsf.gov](mailto:fdarema@nsf.gov).
- James Hickman, Special Advisor to the Division Director, Computer and Information Science and Engineering, Experimental and Integrative Activities, 1060N, telephone: 703-292-8980, e-mail: [jhickman@nsf.gov](mailto:jhickman@nsf.gov).

For questions related to the use of FastLane, contact:

- Helen Walston, Senior Program Assistant, CISE, EIA, 1060N, telephone: (703) 292-8980, e-mail: [hwalston@nsf.gov](mailto:hwalston@nsf.gov).

## IX. OTHER PROGRAMS OF INTEREST

The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF [E-Bulletin](#), which is updated daily on the NSF web site at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's [Custom News Service](#) (<http://www.nsf.gov/home/cns/start.htm>) to be notified of new funding opportunities that become available.

Researchers with interests in bio-molecular computing, computational biology or bioinformatics should also be aware of separate competitive opportunities:

- several recent cross-cutting initiatives are relevant, e.g., Information Technology Research, Nanoscience and Engineering, and Biocomplexity and the Environment, and similar programs may follow;
- opportunities exist in the Biological Sciences Directorate (BIO), specifically in the Division of Biological Infrastructure (DBI), the Division of Environmental Biology (DEB), the Division of Integrative Biology and Neuroscience (IBN), and the Division of Molecular and Cellular Biosciences (MCB);
- within the Engineering Directorate, opportunities exist in the Division of Bioengineering and Environmental Systems (BES); the [Quantitative Systems Biotechnology \(QSB\) Program](#) (NSF 01-37) is supported by a number of Divisions; and
- within the CISE Directorate, in addition to BITS, a complementary and companion program is the [Quantum and Biologically Inspired Computing \(QuBiC\) Program](#).

## **ABOUT THE NATIONAL SCIENCE FOUNDATION**

The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. In accordance with Federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin or disability shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF (unless otherwise specified in the eligibility requirements for a particular program).

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the program announcement/solicitation for further information.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090, FIRS at 1-800-877-8339.

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## **PRIVACY ACT AND PUBLIC BURDEN STATEMENTS**

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to applicant institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies needing information as part of the review process or in order to coordinate programs; and to another Federal agency, court or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates

to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

Pursuant to 5 CFR 1320.5(b), an agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays a valid OMB control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Information Dissemination Branch, Division of Administrative Services, National Science Foundation, Arlington, VA 22230, or to Office of Information and Regulatory Affairs of OMB, Attention: Desk Officer for National Science Foundation (3145-0058), 725 17th Street, N.W. Room 10235, Washington, D.C. 20503.

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